



1/6

SEQUENCE LISTING

5
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<120> Proton Transporters And Uses In Plants

<130> 0399.2004-002

<140> US 09/834,998

<141> 2001-04-13

<150> US 09/644,039

<151> 2000-08-22

<150> US 60/164,808

<151> 1999-11-10

<160> 5

<170> FastSEQ for Windows Version 4.0

<210> 1

<211> 538

<212> PRT

<213> Artificial Sequence

<220>

<223> Arabidopsis - AtNhx1

<400> 1

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| Met | Leu | Asp | Ser | Leu | Val | Ser | Lys | Leu | Pro | Ser | Leu | Ser | Thr | Ser | Asp |
| 1 | | | 5 | | | | | | 10 | | | | | 15 | |
| His | Ala | Ser | Val | Val | Ala | Leu | Asn | Leu | Phe | Val | Ala | Leu | Leu | Cys | Ala |
| | | | 20 | | | | | 25 | | | | | 30 | | |
| Cys | Ile | Val | Leu | Gly | His | Leu | Leu | Glu | Glu | Asn | Arg | Trp | Met | Asn | Glu |
| | | | 35 | | | | 40 | | | | | | 45 | | |
| Ser | Ile | Thr | Ala | Leu | Leu | Ile | Gly | Leu | Gly | Thr | Gly | Val | Thr | Ile | Leu |
| | | | 50 | | | | 55 | | | | 60 | | | | |
| Leu | Ile | Ser | Lys | Gly | Lys | Ser | Ser | His | Leu | Leu | Val | Phe | Ser | Glu | Asp |
| 65 | | | | | 70 | | | | | 75 | | | | 80 | |
| Leu | Phe | Phe | Ile | Tyr | Leu | Leu | Pro | Pro | Ile | Ile | Phe | Asn | Ala | Gly | Phe |
| | | | | 85 | | | | | 90 | | | | | 95 | |
| Gln | Val | Lys | Lys | Lys | Gln | Phe | Phe | Arg | Asn | Phe | Val | Thr | Ile | Met | Leu |
| | | | 100 | | | | | 105 | | | | | 110 | | |
| Phe | Gly | Ala | Val | Gly | Thr | Ile | Ile | Ser | Cys | Thr | Ile | Ile | Ser | Leu | Gly |
| | | | 115 | | | | 120 | | | | | 125 | | | |
| Val | Thr | Gln | Phe | Phe | Lys | Lys | Leu | Asp | Ile | Gly | Thr | Phe | Asp | Leu | Gly |
| | | | 130 | | | | 135 | | | | | 140 | | | |
| Asp | Tyr | Leu | Ala | Ile | Gly | Ala | Ile | Phe | Ala | Ala | Thr | Asp | Ser | Val | Cys |
| 145 | | | | | 150 | | | | | 155 | | | | 160 | |
| Thr | Leu | Gln | Val | Leu | Asn | Gln | Asp | Glu | Thr | Pro | Leu | Leu | Tyr | Ser | Leu |
| | | | | | 165 | | | | 170 | | | | | 175 | |
| Val | Phe | Gly | Glu | Gly | Val | Val | Asn | Asp | Ala | Thr | Ser | Val | Val | Val | Phe |
| | | | 180 | | | | | 185 | | | | | | 190 | |

```

Asn Ala Ile Gln Ser Phe Asp Leu Thr His Leu Asn His Glu Ala Ala
    195                200                205
Phe His Leu Leu Gly Asn Phe Leu Tyr Leu Phe Leu Leu Ser Thr Leu
    210                215                220
Leu Gly Ala Ala Thr Gly Leu Ile Ser Ala Tyr Val Ile Lys Lys Leu
    225                230                235                240
Tyr Phe Gly Arg His Ser Thr Asp Arg Glu Val Ala Leu Met Met Leu
                245                250                255
Met Ala Tyr Leu Ser Tyr Met Leu Ala Glu Leu Phe Asp Leu Ser Gly
                260                265                270
Ile Leu Thr Val Phe Phe Cys Gly Ile Val Met Ser His Tyr Thr Trp
    275                280                285
His Asn Val Thr Glu Ser Ser Arg Ile Thr Thr Lys His Thr Phe Ala
    290                295                300
Thr Leu Ser Phe Leu Ala Glu Thr Phe Ile Phe Leu Tyr Val Gly Met
    305                310                315                320
Asp Ala Leu Asp Ile Asp Lys Trp Arg Ser Val Ser Asp Thr Pro Gly
                325                330                335
Thr Ser Ile Ala Val Ser Ser Ile Leu Met Gly Leu Val Met Val Gly
    340                345                350
Arg Ala Ala Phe Val Phe Pro Leu Ser Phe Leu Ser Asn Leu Ala Lys
    355                360                365
Lys Asn Gln Ser Glu Lys Ile Asn Phe Asn Met Gln Val Val Ile Trp
    370                375                380
Trp Ser Gly Leu Met Arg Gly Ala Val Ser Met Ala Leu Ala Tyr Asn
    385                390                395                400
Lys Phe Thr Arg Ala Gly His Thr Asp Val Arg Gly Asn Ala Ile Met
                405                410                415
Ile Thr Ser Thr Ile Thr Val Cys Leu Phe Ser Thr Val Val Phe Gly
    420                425                430
Met Leu Thr Lys Pro Leu Ile Ser Tyr Leu Leu Pro His Gln Asn Ala
    435                440                445
Thr Thr Ser Met Leu Ser Asp Asp Asn Thr Pro Lys Ser Ile His Ile
    450                455                460
Pro Leu Leu Asp Gln Asp Ser Phe Ile Glu Pro Ser Gly Asn His Asn
    465                470                475                480
Val Pro Arg Pro Asp Ser Ile Arg Gly Phe Leu Thr Arg Pro Thr Arg
                485                490                495
Thr Val His Tyr Tyr Trp Arg Gln Phe Asp Asp Ser Phe Met Arg Pro
    500                505                510
Val Phe Gly Gly Arg Gly Phe Val Pro Phe Val Pro Gly Ser Pro Thr
    515                520                525
Glu Arg Asn Pro Pro Asp Leu Ser Lys Ala
    530                535

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<210> 2

<211> 669

<212> PRT

<213> Artificial Sequence

<220>

<223> Human - HsNhe-6

<400> 2

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Met Ala Arg Arg Gly Trp Arg Arg Ala Pro Leu Arg Arg Gly Val Gly
  1              5              10              15
Ser Ser Pro Arg Ala Arg Arg Leu Met Arg Pro Leu Trp Leu Leu Leu
    20              25              30

```

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Ala | Val | Gly | Val | Phe | Asp | Trp | Ala | Gly | Ala | Ser | Asp | Gly | Gly | Gly | Gly |
| | | 35 | | | | | 40 | | | | | 45 | | | |
| Glu | Ala | Arg | Ala | Met | Asp | Glu | Glu | Ile | Val | Ser | Glu | Lys | Gln | Ala | Glu |
| | | 50 | | | | 55 | | | | | 60 | | | | |
| Glu | Ser | His | Arg | Gln | Asp | Ser | Ala | Asn | Leu | Leu | Ile | Phe | Ile | Leu | Leu |
| 65 | | | | | 70 | | | | | 75 | | | | | 80 |
| Leu | Thr | Leu | Thr | Ile | Leu | Thr | Ile | Trp | Leu | Phe | Lys | His | Arg | Arg | Ala |
| | | | | 85 | | | | | 90 | | | | | 95 | |
| Arg | Phe | Leu | His | Glu | Thr | Gly | Leu | Ala | Met | Ile | Tyr | Gly | Leu | Leu | Val |
| | | | 100 | | | | | 105 | | | | | 110 | | |
| Gly | Leu | Val | Leu | His | Tyr | Gly | Ile | His | Val | Pro | Ser | Asp | Val | Asn | Asn |
| | | 115 | | | | | 120 | | | | | 125 | | | |
| Val | Thr | Leu | Ser | Cys | Glu | Val | Gln | Ser | Ser | Pro | Thr | Thr | Leu | Leu | Val |
| 130 | | | | | | 135 | | | | | 140 | | | | |
| Thr | Phe | Asp | Pro | Glu | Val | Phe | Phe | Asn | Ile | Leu | Leu | Pro | Pro | Ile | Ile |
| 145 | | | | | 150 | | | | | 155 | | | | | 160 |
| Phe | Tyr | Ala | Gly | Tyr | Ser | Leu | Lys | Arg | Arg | His | Phe | Phe | Arg | Asn | Leu |
| | | | | 165 | | | | | 170 | | | | | 175 | |
| Gly | Ser | Ile | Leu | Ala | Tyr | Ala | Phe | Leu | Gly | Thr | Ala | Ile | Ser | Cys | Phe |
| | | | 180 | | | | | 185 | | | | 190 | | | |
| Val | Ile | Gly | Ser | Ile | Met | Tyr | Gly | Gly | Val | Thr | Leu | Met | Lys | Val | Thr |
| | | 195 | | | | | 200 | | | | | 205 | | | |
| Gly | Gln | Leu | Ala | Gly | Asp | Phe | Tyr | Phe | Thr | Asp | Cys | Leu | Leu | Phe | Gly |
| | | 210 | | | | 215 | | | | | 220 | | | | |
| Ala | Ile | Val | Ser | Ala | Thr | Asp | Pro | Val | Thr | Val | Leu | Ala | Ile | Phe | His |
| 225 | | | | | 230 | | | | | 235 | | | | | 240 |
| Glu | Leu | Gln | Val | Asp | Val | Glu | Leu | Tyr | Ala | Leu | Leu | Phe | Gly | Glu | Ser |
| | | | | 245 | | | | | 250 | | | | | 255 | |
| Val | Leu | Asn | Asp | Ala | Val | Ala | Ile | Val | Leu | Ser | Ser | Ser | Ile | Val | Ala |
| | | | 260 | | | | | 265 | | | | | 270 | | |
| Tyr | Gln | Pro | Ala | Gly | Asp | Asn | Ser | His | Thr | Phe | Asp | Val | Thr | Ala | Met |
| | | 275 | | | | | 280 | | | | | 285 | | | |
| Phe | Lys | Ser | Ile | Gly | Ile | Phe | Leu | Gly | Ile | Phe | Ser | Gly | Ser | Phe | Ala |
| | | 290 | | | | 295 | | | | | 300 | | | | |
| Met | Gly | Ala | Ala | Thr | Gly | Val | Val | Thr | Ala | Leu | Val | Thr | Lys | Phe | Thr |
| 305 | | | | | 310 | | | | | 315 | | | | | 320 |
| Lys | Leu | Arg | Glu | Phe | Gln | Leu | Leu | Glu | Thr | Gly | Leu | Phe | Phe | Leu | Met |
| | | | | 325 | | | | | 330 | | | | | 335 | |
| Ser | Trp | Ser | Thr | Phe | Leu | Leu | Ala | Glu | Ala | Trp | Gly | Phe | Thr | Gly | Val |
| | | | 340 | | | | | | 345 | | | | 350 | | |
| Val | Ala | Val | Leu | Phe | Cys | Gly | Ile | Thr | Gln | Ala | His | Tyr | Thr | Tyr | Asn |
| | | | 355 | | | | 360 | | | | | 365 | | | |
| Asn | Leu | Ser | Thr | Glu | Ser | Gln | His | Arg | Thr | Lys | Gln | Leu | Phe | Glu | Leu |
| | | | | | | 375 | | | | | 380 | | | | |
| Leu | Asn | Phe | Leu | Ala | Glu | Asn | Phe | Ile | Phe | Ser | Tyr | Met | Gly | Leu | Thr |
| 385 | | | | | 390 | | | | | 395 | | | | | 400 |
| Leu | Phe | Thr | Phe | Gln | Asn | His | Val | Phe | Asn | Pro | Thr | Phe | Val | Val | Gly |
| | | | | 405 | | | | | 410 | | | | | 415 | |
| Ala | Phe | Val | Ala | Ile | Phe | Leu | Gly | Arg | Ala | Ala | Asn | Ile | Tyr | Pro | Leu |
| | | | | 420 | | | | 425 | | | | | 430 | | |
| Ser | Leu | Leu | Leu | Asn | Leu | Gly | Arg | Arg | Ser | Lys | Ile | Gly | Ser | Asn | Phe |
| | | | | 435 | | | 440 | | | | | 445 | | | |
| Gln | His | Met | Met | Met | Phe | Ala | Gly | Leu | Arg | Gly | Ala | Met | Ala | Phe | Ala |
| | | 450 | | | | 455 | | | | | 460 | | | | |
| Leu | Ala | Ile | Arg | Asp | Thr | Ala | Thr | Tyr | Ala | Arg | Gln | Met | Met | Phe | Ser |
| 465 | | | | | 470 | | | | | 475 | | | | | 480 |
| Thr | Thr | Leu | Leu | Ile | Val | Phe | Phe | Thr | Val | Trp | Val | Phe | Gly | Gly | Gly |
| | | | | 485 | | | | | 490 | | | | | 495 | |

```

Thr Thr Ala Met Leu Ser Cys Leu His Ile Arg Val Gly Val Asp Ser
      500                      505                      510
Asp Gln Glu His Leu Gly Val Pro Glu Asn Glu Arg Arg Thr Thr Lys
      515                      520                      525
Ala Glu Ser Ala Trp Leu Phe Arg Met Trp Tyr Asn Phe Asp His Asn
      530                      535                      540
Tyr Leu Lys Pro Leu Leu Thr His Ser Gly Pro Pro Leu Thr Thr Thr
545                      550                      555                      560
Leu Pro Ala Cys Cys Gly Pro Ile Ala Arg Cys Leu Thr Ser Pro Gln
      565                      570                      575
Ala Tyr Glu Asn Gln Glu Gln Leu Lys Asp Asp Asp Ser Asp Leu Ile
      580                      585                      590
Leu Asn Asp Gly Asp Ile Ser Leu Thr Tyr Gly Asp Ser Thr Val Asn
      595                      600                      605
Thr Glu Pro Ala Thr Ser Ser Ala Pro Arg Arg Phe Met Gly Asn Ser
      610                      615                      620
Ser Glu Asp Ala Leu Asp Arg Glu Leu Ala Phe Gly Asp His Glu Leu
625                      630                      635                      640
Val Ile Arg Gly Thr Arg Leu Val Leu Pro Met Asp Asp Ser Glu Pro
      645                      650                      655
Pro Leu Asn Leu Leu Asp Asn Thr Arg His Gly Pro Ala
      660                      665

```

```

<210> 3
<211> 633
<212> PRT
<213> Artificial Sequence

```

```

<220>
<223> Yeast - ScNhx1

```

```

<400> 3
Met Leu Ser Lys Val Leu Leu Asn Ile Ala Phe Lys Val Leu Leu Thr
 1                      5                      10                      15
Thr Ala Lys Arg Ala Val Asp Pro Asp Asp Asp Asp Glu Leu Leu Pro
      20                      25                      30
Ser Pro Asp Leu Pro Gly Ser Asp Asp Pro Ile Ala Gly Asp Pro Asp
      35                      40                      45
Val Asp Leu Asn Pro Val Thr Glu Glu Met Phe Ser Ser Trp Ala Leu
      50                      55                      60
Phe Ile Met Leu Leu Leu Leu Ile Ser Ala Leu Trp Ser Ser Tyr Tyr
65                      70                      75                      80
Leu Thr Gln Lys Arg Ile Arg Ala Val His Glu Thr Val Leu Ser Ile
      85                      90                      95
Phe Tyr Gly Met Val Ile Gly Leu Ile Ile Arg Met Ser Pro Gly His
      100                     105                     110
Tyr Ile Gln Asp Thr Val Thr Phe Asn Ser Ser Tyr Phe Phe Asn Val
      115                     120                     125
Leu Leu Pro Pro Ile Ile Leu Asn Ser Gly Tyr Glu Leu Asn Gln Val
      130                     135                     140
Asn Phe Phe Asn Asn Met Leu Ser Ile Leu Ile Phe Ala Ile Pro Gly
145                      150                      155                      160
Thr Phe Ile Ser Ala Val Val Ile Gly Ile Ile Leu Tyr Ile Trp Thr
      165                      170                      175
Phe Leu Gly Leu Glu Ser Ile Asp Ile Ser Phe Ala Asp Ala Met Ser
      180                      185                      190

```

Pro Ala Asp Phe Ser Ser Gln Asn His
625 630

<210> 4
 <211> 11
 <212> PRT
 <213> Unknown

<220>
 <223> Putative Amiloride Binding Site From Human Nhe1

<400> 4
 Asp Val Phe Phe Leu Phe Leu Leu Pro Pro Ile
 1 5 10

<210> 5
 <211> 38
 <212> PRT
 <213> Unknown

<220>
 <223> PCR Primer Used To Amplify AtNhx1 ORF

<400> 5
 Gly Gly Cys Cys Cys Gly Gly Gly Ala Thr Gly Gly Ala Thr Thr Cys
 1 5 10 15
 Thr Cys Thr Ala Gly Thr Gly Thr Cys Gly Ala Ala Ala Cys Thr Gly
 20 25 30
 Cys Cys Thr Thr Cys Gly
 35